FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 84-46

3430 Evaluation
December 4, 1984

PSW FOREST AND RANGE EXPERIMENT STATION
JUL 29 1985
STATION LIBRARY COPY

A BIOLOGICAL EVALUATION OF UPPER CHIQUITO AND GRANITE CREEK CAMPGROUNDS, MINARETS RANGER DISTRICT, SIERRA NATIONAL FOREST

John Kliejunas, Plant Pathologist
John Pierce, Entomologist

ABSTRACT

Upper Chiquito and Granite Creek Campgrounds on the Minarets Ranger District were evaluated for pest problems which may affect management objectives for the sites. The major pests noted at Upper Chiquito included annosus root disease, red fir dwarf mistletoe, and lodgepole pine dwarf mistletoe. Management alternatives discussed include no change in current management direction, annosus root disease management, and dwarf mistletoe management. Lodgepole pine dwarf mistletoe, western gall rust, and mountain pine beetle were common at Granite Creek. Management alternatives discussed for the site include no change in current management direction and vegetation management.

INTRODUCTION

At the request of the Forest Supervisor, Sierra National Forest, Forest Pest Management conducted a biological evaluation of the Upper Chiquito and Granite Creek Campgrounds on the Minarets Ranger District during the week of August 13-17, 1984. The evaluation was coordinated in the field with Walley McCray (Forest Landscape Architect) and Mark Smith (Forest Silviculturist) from the Supervisor's Office, and Bill Skovran (Resource Officer) from the Minarets District.

The Forest's objective for recreational sites is to maintain or improve the existing outdoor recreational experience by, in part, minimizing adverse effects of insect and disease activities. The objectives of this evaluation were to identify existing and potential pest situations, to provide information on the expected future conditions of each site, and to provide the Minarets District with alternatives for integrating pest management considerations into a vegetation management plan for each of the two campgrounds.

USDA, FOREST SERVICE, PACIFIC SOUTHWEST REGION
State and Private Forestry, Forest Pest Management
630 Sansome Street, San Francisco, California 94111

UPPER CHIQUITO CAMPGROUND

Observations

Vegetation at this 6,800 foot elevation campground consists of an overstory composed primarily of red fir and lodgepole pine, with minor amounts of white fir, Jeffrey pine, and sugar pine. Understory vegetation is characterized by scattered thickets of true fir and lodgepole pine saplings and small poles, some Jeffrey and sugar pine reproduction, and a lack of hardwoods and shrubs. Some trees in the area were marked and cut in the fall of 1983, with marking done on the basis of hazard tree and high risk tree removal. The existing road along the west end of the campground is to be closed because of its proximity to Chiquito Creek. Grading for a new road about 100 to 150 feet upslope has begun.

Pests noted included annosus root disease (Fomes annosus) on red fir, red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae), lodgepole pine dwarf mistletoe (Arceuthobium americanum), and Cystospora canker (Cystospora abietis). Because the pests observed were generally found throughout the campground, a map with site-specific notes is not included with this evaluation.

Annosus root disease was prevalent throughout the western portion of the campground. Conks of F. annosus were common in hollow true fir stumps in the vicinity of the proposed loop uphill from the existing loop at the western end of the campground. About eight overmature red firs were removed from this area last fall. Two red fir stumps infested with F. annosus were adjacent to two, recently dead, 12 inch dbh red firs. The root disease was not found in the area of the proposed eastern loop. This eastern area of the campground is relatively open with rocky outcrops, and with more compacted and drier soil than the western portion.

Red fir dwarf mistletoe was common on overstory red firs throughout the campground. Most of the trees, especially in the proposed eastern loop, were heavily infected, with dwarf mistletoe ratings of 5 and 6. Many of the mistletoe-infected trees also had branch flagging characteristic of Cytospora canker. Dwarf mistletoe was present on understory red fir saplings and poles in the vicinity of the restroom at the western end of the campground and on saplings in the dense thickets of reproduction that occur in the vicinity of the proposed eastern loop. Lodgepole pine dwarf mistletoe occured on overstory and understory trees wherever the tree species occurred.

A potential for development of hazardous trees from decay was noted. Red firs in the area where numerous trees were removed last year had bole scars as a result of logging. These open wounds are excellent infection courts for decay fungi and annosus root disease. A 100 foot high ponderosa pine on the stream side of the existing road in the same general area had a hollow butt log.

Management Alternatives

1. No change in current management direction. Current levels of annosus root disease and red fir dwarf mistletoe activity will contribute to a gradual reduction of the red fir component of the stand. Annosus root disease centers

will continue to expand as long as there are root contacts with surrounding live red firs. Trees with substantial annosus root and butt rot, for example, those in the western portion of the campground, will have a high probability of failure, especially during winter storms . New annosus centers may be created by infection of freshly-cut stumps and wounds from spores of the fungus when hazardous trees are removed, when blow-down occurs, or when trees are removed for road construction. The vegetative composition in and around annosus centers will change over time, with the percentage of red fir diminishing and percentage of pines that are resistant to the strain of F. annosus on true fir increasing.

Dwarf mistletoe in red fir and lodgepole pine will increase as understory trees are infected from the overstory source of infection. Dwarf mistletoe may become especially severe in dense aggregations of red fir infected with annosus root disease because of slow tree growth. Insects such as the fir engraver (Scolytus ventralis) may contribute to mortality, particularly in trees weakened by root disease and dwarf mistletoe.

2. Annosus root disease management. The most effective control for annosus root disease is prevention. The probability of the formation of new centers, and the resulting adverse effects of the disease discussed in Alternative 1, can be reduced by the application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to all freshly-cut conifer stumps in the campground (see FSM 3205, 2331.33, R-5 Supplement No. 90). Thinning active annosus centers may increase the tolerance of true fir to infection by increasing their rate of root regeneration and replacement and will minimize opportunities for root contact and subsequent spread. In addition, thinning the dense aggregations of true fir will alleviate overstocking as a predisposing factor to insect attack.

Basal wounds on true fir are entry courts for F. annosus. Wounding of residual trees when thinning or when cutting trees for other reasons should be avoided to prevent subsequent decay. Wounded trees should be considered for removal.

3. Dwarf mistletoe management. Dwarf mistletoes can be controlled by eradication or by suppression. Eradication of dwarf mistletoe, which would involve removing infected hosts, is not viable at Upper Chiquito because of its widespread occurrence on both true fir and lodgepole pine.

Suppression of dwarf mistletoe involves minimizing the effects of the disease while tolerating a low level of infection. Various tactics are available for reducing the impact of dwarf mistletoe in recreation sites.

a. Remove infected overstory trees to protect regeneration. To prevent infection of understory trees, infected overstory trees can be removed to eliminate the source of inoculum. The understory can then be thinned and, in the case of lodgepole pine, pruned to remove dwarf mistletoe infections.

b. Thinning. Thinning of infested stands will aid in maintaining optimum growth of residuals and will reduce stress. Following release, lightly infected residuals most likely will vertically outgrow the dwarf mistletoe. In the case of red fir, infected trees growing at optimum stocking levels on good

sites can achieve a rate of height growth greater than the rate of vertical spread of the dwarf mistletoe. Keep in mind that all freshly cut stumps created when thinning should be treated with borax to prevent invasion by F. annosus.

In addition to minimizing the impact of dwarf mistletoe, thinning dense aggregations of true fir will minimize opportunities for root contact and subsequent spread of F. annosus. Increased tree vigor following thinning will also reduce the risk of bark beetle attack of lodgepole pine as well as true fir.

c. Encourage tree species diversity. A mix of non-susceptible species in infested stands provides a barrier to spread of dwarf mistletoe and annosus root disease. An increase of the present species mix at Upper Chiquito would reduce future impacts of red fir and lodgepole pine dwarf mistletoes. Encouraging the existing Jeffrey pines and sugar pines, which are non-hosts to the dwarf mistletoes and to the true fir strain of F. annosus present, should be considered. Some areas, such as the proposed eastern loop, could be planted to Jeffrey pine. These planted trees would provide a barrier to spread of red fir dwarf mistletoe, as well as provide screening and a barrier to recreationists which would reduce the soil compaction now present. Planting of sugar pine not resistant to rust should be discouraged because of the probability of their being impacted by white pine blister rust (Cronartium ribicola). Favoring pines over true fir would also minimize the risk of annosus root disease spread.

GRANITE CREEK CAMPGROUND

Observations

This 7,000 foot elevation campground is located within a stand of almost pure lodgepole pine with a few scattered red fir and ponderosa pine present. Because of the campground's proximity to the Minarets Wilderness, it has received heavy, unregulated use from recreationists, horses, and vehicular traffic for a number of years.

Lodgepole pines are being impacted by dwarf mistletoe (Arcethobium americanum), western gall rust (Endocronartium harknessii), and the mountain pine beetle (Dendroctonus ponderosae). Dwarf mistletoe occurs at various levels of intensity on overstory lodgepole pines. All groups of lodgepole pine reproduction examined were also infected. Gall rust cankers were common. Rust cankers in the main bole and accompanying decay were responsible for bole failures. A high resident mountain pine beetle population is present. There are numerous trees currently infested, and groups or patches of lodgepole pine snags killed by the beetle in past years occur throughout the area. Because the pests occurred throughout the Granite Creek area, a site-specific map is not included with this evaluation.

Two additional problems were impacting the campground. Overstory red fir in the vicinity of the foot bridge were infected with dwarf mistletoe Arceuthobium abietinum f. sp. magnificae). Soil compaction from vehicular traffic and overfertilization from concentrations of pack horses were contributing to tree stress in areas adjacent to the main road.

Management Alternatives

1. No change in current management direction. Lodgepole pine dwarf mistletoe will intensify and continue to reduce the vigor of overstory trees. Pine regeneration will be infected because of the overstory source of inoculum. Rust cankers in main stems will result in additional tree failures. Although most of the tree failures would probably occur during winter storms and not cause injury to people or property, the potential for injury during high-use periods of the year will remain.

A considerable number of lodgepole pines have been killed by the mountain pine beetle at Granite Creek in the past, and additional mortality can be expected unless corrective measures are taken. Increased mountain pine beetle activity, resulting in part from tree stress factors mentioned above, could accelerate the rate of tree mortality.

2. Vegetation management. The high levels of dwarf mistletoe infestation are contributing to tree stress. These stressed trees help maintain a chronically high mountain pine beetle population. Because the dwarf mistletoe infections are widespread and involve all size classes of trees, the only way to eliminate the disease would be to clear-cut large patches of trees and then either maintain a host-free buffer around uninfected lodgepole pine regeneration, or to

regenerate with non-host trees. These young stands would be essentially free of mountain pine beetle attack until the trees attained large pole size. However, such treatment would alter the appearance of Granite Creek for a substantial period of time and may not achieve management objectives.

Direct control of the mountain pine beetle by spraying, peeling the bark of infested trees, and/or by salvage logging is possible, but probably not feasible because of the recreational emphasis in the area, the size of the area involved, and the current low value of lodgepole pine. In addition, these direct control measures are quite expensive to use and would not be effective unless applied annually.

Other treatments are available to compensate for the stress caused by dwarf mistletoe and to reduce the impact of the beetle without eliminating them.

a. Thin. Thinning dense aggregations would increase individual tree vigor, partially compensate for the stress caused by dwarf mistletoe infection, and would decrease the susceptibility of lodgepole pines to the mountain pine beetle. Thinning reproduction at an early age would reduce screening, but would also reduce competition with the overstory, stimulate the growth of the reproduction, and is more likely to produce healthy replacement trees by reducing the impact of gall rust. Most rust infections occur on lower branches of young trees. Removing these infected trees at an early age will prevent rust development and subsequent girdling. Because there is some evidence of resistance to the rust in lodgepole pine, thinning of moderately to heavily-infected trees may aid in selecting for a higher level of resistance in the stand.

Thinning will not eliminate dwarf mistletoe, but will aid in maintaining optimum growth of residuals and reduce tree stress. Following release, lightly infected residuals may vertically outgrow the dwarf mistletoe. Noninfected trees should be favored as leave trees. Increased tree vigor following thinning will also reduce the risk of mountain pine beetle attack.

b. Prune dwarf mistletoe brooms. Some overstory lodgepole pines at Granite Creek have large dwarf mistletoe brooms. These brooms are a drain on the energy reserves of a tree. Pruning the brooms will increase vigor and extend the life of the tree 10 to 15 years if at least 30 percent live crown remains after pruning. Because there are usually infections above the highest broom, broom pruning will not reduce the spread or intensification of dwarf mistletoe in the tree or in the stand.

c. Remove high risk trees and sanitize. Lodgepole pines with signs of low vigor, such as short needles, reduced needle complement, off-color foliage, branch dieback and flat-topped crowns, have a high probability of becoming the center of a bark beetle group kill. The number of group kills can be reduced by removing high risk trees while they are still green. The mountain pine beetle releases a pheromone after a successful attack. This pheromone attracts additional mountain pine beetles which may land on nearby trees and overwhelm them by sheer numbers. Removing a high risk tree while it is still green can eliminate the center of a potential bark beetle kill.

Because many of the high risk trees in the overstory are heavily infected with dwarf mistletoe, removing them would slow the spread of dwarf mistletoe to nearby uninfected reproduction. The removal of all trees with 6-class dwarf mistletoe ratings of 5 and 6 should be considered, because these trees have a high probability of dying in the next 10 to 15 years. Removal of trees with rust stem cankers would reduce the number of potentially hazardous trees.

d. Create vegetative or physical barriers. Trees in the heavily-used portions of Granite Creek, near the entrance for example, are being stressed by unregulated human and pack horse use as well as by insects and disease. The planting and use of shrubs and other vegetation suited to the site for traffic management and for defining of specific sites for camping should be considered. Delimiting specific areas for vehicular use and for corraling of horses would also reduce soil compaction and subsequent tree stress.

APPENDIX

BIOLOGY OF PEST ORGANISMS

Following are summaries of the biology of diseases and insects causing mortality or damage in the Upper Chiquito and Granite Creek Campgrounds.

Annosus Root Disease (Fomes annosus). Fomes annosus is a fungus that attacks a wide range of woody plants, causing a decay of the roots and lower bole and death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed. Infected pines are usually killed rather rapidly when the fungus girdles the root collar. In contrast, older true firs can survive infection for many years, although butt and root rot may become extensive, resulting in tree weakening and windthrow.

During periods favorable to the fungus, fruiting bodies form in decayed stumps, under the bark of dead trees, or in the duff at the root collar. The fungus becomes established in freshly cut stumps from air-borne spores produced by the conks, and then grows into the root system. True firs can also be infected by spores invading fresh basal wounds. The fungus then spreads to healthy roots of surrounding susceptible conifers via root contacts. In general, infections will cross from pine to true fir; however, rarely is the fungus observed to go from true fir to pine. Local spread of the fungus outward from a stump typically results in the formation of disease centers, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach barrriers such as openings in the stand or groups of nonsusceptible plants.

The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps. Young susceptible tree species often become infected and die after their roots contact old infected root systems in the soil.

Dwarf Mistletoes. Red fir (A. abietinum f. sp. magnificae); lodgepole pine (A. americanum): Red fir is the only host for red fir dwarf mistletoe, just as lodgepole pine dwarf mistletoe infects only lodgepole pine. Other conifers are rarely infected and hardwoods are immune to thse pathogens. The pathogens are obligate parasites obtaining their nutrients, minerals and water from the host.

These parasites are dioecious, perennial higher plants that produce seeds as their means of spread. In the fall of the year when the fruit falls from the stem, the seed is ejected upward and outward. The seed adheres to any surface it contacts. When the seed lands in the crown of a susceptible host tree, it adheres to a needle or limb and overwinters. The following spring it germinates and penetrates the limb. For the next 2 to 4 years the plant grows in the tree limb, developing a rootlike endophytic system in the inner bark and outer sapwood. It then produces aerial shoots and in another 2 to 4 years produces reproductive structures.

Spread of dwarf mistletoe is limited to the distance traveled by the seed, which from overstory to understory is usually 20 to 60 feet, but may be as much as 100 feet if wind assists the seeds. As a rule of thumb, dwarf mistletoe can spread horizontally to the understory a distance equal to the height of the

infection in the overstory tree. Because of the various limits to spread, such as height of the source plant, angle of discharge, wind velocity, stand density, etc., the actual spread rate through an even-aged stand is about 1 to 2 feet per year.

Western Gall Rust (Endocronartium harknessii). Western gall rust causes branch galls and trunk cankers on nearly all species of hard pines. The rust fungus produces yellow to orange-colored spores (aeciospores) on the surface of the galls during cool, moist, spring weather. The spores are wind disseminated and can infect other pines directly. Invasion of the cambium through the pine bark by the rust fungus results in the formation of woody galls. Galls on branches are typically spindle-shaped. The galls continue to enlarge and produce new spores each spring until they have girdled and killed the branch or stem. Girdling of branches results in a reduction of tree growth. Trunk cankers deform and reduce the strength of the bole.

Mountain Pine Beetle (Dendroctonus ponderosae). Adults could attack lodgepole, ponderosa or sugar pines from late June through August. They bore 2 to 4 foot long vertical egg galleries in the phloem/cambium region from breast height to mid-crown, and lay eggs in niches along the sides of the gallery. A J-shaped hook is common at the lower 1 to 2 inches of the gallery. The larvae feed in mines perpendicular to the main gallery, and construct small pupal cells at the end of these mines, where they pupate and transform into adults. There is a single generation per year.

Damage is recognized by pitch tubes along the bole and red boring dust in bark crevices and on the ground. After successful attack, foliage becomes greenish yellow, then reddish brown, within a short period. The mountain pine beetle can cause significant losses in densely-stocked stands of pole-size trees.